Autopsy of Charged Higgs MC Generation on ATLAS

H+ LHC Higgs XS Meeting

Haleh Hadavand Lluïsa-Maria Mir

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H^+ Organization

Analysis	Contact	Physics subgroup	Physics group	Meetings
$H^+ \rightarrow \tau\nu$	Justin Griffiths & Michael Pitt	HBSM	Higgs	Friday 2:00 pm
$H^+ \rightarrow tb$	Lluïsa-M. Mir	HTop / HBSM	Higgs	Tuesday 3:00 pm Friday 3:30 pm
$H^+ \rightarrow cb,cs$	Davide Gerbaudo	Top Properties / HBSM	Top / Higgs	No regular meetings established yet
$H^+ \rightarrow W^+H, W^+Z$	Carl Bryan Gwilliam & Reina Coromoto Camacho Toro	Diboson / Multilepton / Exotics	Exotics	Wed 3:30 pm
$H^{++} \rightarrow$ (1) WW (2) VBF(WW) (3) ll	(1) Venugopal Ellajosyula & Cristinel Diaconu (2) Georges Azuelos & Kazuya Mochizuki (3) Miha Muškinja & Federico Scutti	(1) HBSM (2) Same Sign WW (3) LPX	(1) Higgs (2) SM (3) Exotics	(1) Tue 1:00 pm (2) Tue 1:00 pm (3) Wed 11:00 am

H^+ MC (Recommendations in Summer 2015)

- Use new model from Celine Degrande 'bh-t_4FS_yb2/bh-t_4FS_yt2' within MadGraph
- Factorization and renormalization scales:
  - Low mass: Choose a value of $\mu_{F,R}$ between $m_{top}/2$ and m_{top}
  - Intermediate mass : $\mu_{F,R}$ = 125 GeV
  - High mass : Variable scale $\mu_{R,F} = H_T/3 \equiv \frac{1}{3}\sum_i \sqrt{m(i)^2 + p_T(i)^2}$ i runs over all particles of final state: H^+, t, b
- Use of lowered shower scale by factor of 4 before generating events

H^+ MC (Generation for ICHEP)

- Use new model from Celine Degrande '2HDMtypeII' within MadGraph
- Factorization and renormalization scales:
  - Low mass: $\mu_{F,R} = 1/2\ H_T = 1/2\ \sqrt{(m_i^2 + p_{Ti}^2)}$
  - Intermediate mass : $\mu_{F,R} = 1/3\ m(H^+)$
  - High mass : $\mu_{F,R} = 1/3\ m(H^+)$
- Use of lowered shower scale by factor of 4 before generating events

H^+ MC (Situation Now)

- New recommendations never requested (by us) and never provided (by theorists)
- Theorists provided folders with new recommendations implemented in MadGraph v2.4.3 linked MadGraph wiki page, being validated by PMG
- Looks like cross-section is affected quite significantly but not so much the differential distributions
- Will not use these recommendations, but should be prepared for next campaign
- Zachary Marshall tried (simply grabbing the folder, pointing it at 2.4.3 installation, and running it) and gives a crash for missing dependencies
- Need better communication from theorists to LHC Higgs XS group contacts and from those to people in charge of generating samples

Autopsy of Events

- 5/15/15-Email from Martine Bosman inquiring about presentation from Maria made in Dec 2014
- 6/4/15-Response from theorists on matter suggesting folders could be sent to us in addition information about shower scales and factorization/normalization scales
  - Takeaway from ATLAS side…still use our model 2HDMTypeII but change scales as suggested
  - Somehow the release of needed folders was not followed through by anyone
- 6/11/15 – email forwarded to me by Jana as responsible for generating samples on ATLAS
- 6/16/15 - contact with theorists about technicalities of changing shower scales
- 6/24/15 – implemented changes into our MC requests using the on-the-fly running of madgraph

Revisited

- 10/12/16 – Started conversations with Maria at the Charged 2016 meeting at Uppsala
  - Maria sent me folders to use linked here: https://cp3.irmp.ucl.ac.be/projects/madgraph/wiki/chargedHiggs#no1
- 11/7/16 – request for clarification of models to be used within madgraph
  - New set of folders sent from Marius after some discussion of technicalities of ATLAS release structure and use of madgraph version

What happened? What to do in the future

- Clearly theorists and experimentalists were talking past each other ☺
- How do we fix this in the future?
- Need to use LHC Higgs XS twikis for clear instructions of latest recommendations
  - Include models, any changed parameters from the default values, etc
  - Maybe it was somewhere and I personally didn't know of it
- Release structure of experiments linked to version of Madgraph maybe needs to be relayed for technicalities
- I think to be be safe it would be good to share JO snippets to theorist to make sure things are implemented as suggested within Madgraph